

“I hereby declared this report is mine except summary and each quotation
that I have mentioned that resources”

Signature :

Author's Name :

Date :

DEDICATION

To my beloved family for their encouragement and support especially, and for their understanding in the way I am

ACKNOWLEDGEMENTS

This report teaches and provides me a basic knowledge of engineering and helps me to understanding more about project toilet wheelchair. Then, I know the basic theory of wheelchair. This report inevitably involves many helping hands. First of all, I am extremely grateful and thanks to my supervisor, Mr. Syahibudil Ikhwan B. Hj Abdul Kudus for all the guidance and critics given to me directly or indirectly, and also his friendly in time to teach and explain to me amicably.

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ABSTRACT

This project focuses on the process of designing and optimization a toilet wheelchair. This study present the study of typical wheelchair uses in market. The main objective of the project is to come out with new idea to enhance the reliability and quality of the toilet wheelchair design of toilet wheelchair and to optimize existing toilet wheelchair design concept for elderly and disabled people. Meanwhile, the research problem is about the existing concept. Then, this project has to optimize the structure and the problem of user when using the wheelchair. From the research, there are many structure wheelchair in market value to consider before optimization. From the research the new idea will come out to optimize the existing concept. This research very important to know the strength of structure wheelchair. The strength of the structure for existing concept has no structure strength and should be to study for consumer safety. The new design is consider the ergonomic and strength of the structure . This design approve by analysis of the two concepts between existing concept and optimization. After done the analysis, the existing concept compare with optimization to know the best design . The objective achieve because after optimization factor of safety increasing before existing concept. When factor of safety increase, this approve the strength of structure optimization better than existing concept. This product can commercialized for disable people and elderly because can easy to use. In the future, the product can produces because this product have high requirement from customer.

ABSTRAK

Projek ini fokus kepada proses rekabentuk dan optimasi baru untuk kerusi roda tandas. Laporan ini menerangkan tentang bahagian-bahagian yang ada di kerusi roda melalui produk- produk yang telah sedia ada. Objektif utama ialah mewujudkan satu rekabentuk baru dan optimasi rekabentuk yang sedia ada untuk orang kurang upaya dan orang tua. Kajian ini mempunyai masalah apabila terpaksa mengkaji konsep yang telah ada. Konsep yang sedia ada ini perlu dioptimasikan kerana terdapat banyak kelemahannya. Daripada penyelidikan yang dibuat, idea baru terhasil untuk menghasilkan optimasi baru daripada konsep yang sedia ada. Kajian ini penting untuk mengetahui kekuatan struktur kerusi roda. Struktur untuk konsep yang ada tidak mempunyai struktur yang kukuh dan perlu diambil kira untuk keselamatan pengguna. Rekabentuk yang baru mengambil kira ergonomic dan kekuatan struktur kerusi roda. Rekabentuk ini dibuktikan dengan analisis dua konsep antara konsep sedia ada dan optimasi. Selepas itu, kajian ini membandingkan konsep baru dan lama untuk mengetahui rekabentuk yang terbaik. Objektif ini terbukti kerana selepas optimasi faktor keselamatan lebih tinggi daripada konsep sedia ada. Apabila faktor keselamatan meningkat, terbukti kekuatan struktur selepas optimasi lebih baik daripada konsep sedia ada. Produk ini boleh dikomersialkan untuk orang kurang upaya dan orang tua kerana senang digunakan. Pada masa hadapan, produk boleh dihasilkan kerana produk ini mempunyai permintaan yang tinggi daripada pelanggan.

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LIST OF SYMBOLS

F	= Force
τ	= Torque
v	= Velocity
a	= Acceleration
ω	= Angular velocity
σ	= Stress
ε	= Strain
l	= Length
t	= Time
m	= Meter
M	= Moment
E	= Elastic modulus

CHAPTER I

INTRODUCTION

1.1 Introduction

Wheelchair is one of the most important transports for disabled and elderly people. Normally, wheelchairs are used by people who cannot walk or having difficulties in walking due to illness, injury, or disability. Wheelchairs are use mostly for elderly people who cannot stand for a long time because their joint between the thigh and the lower part of the leg are very weak. Without wheelchair the disabled and elderly people will not able to go anywhere. Wheelchair is meant to move either manually by pushing the wheels with hands or by automated systems. Wheelchair has become a tool enhance live and change perceptions. People with disabilities are also searching for their collective identify.

In this project, all aspects regarding to design a toilet wheelchair for the purpose of the reliability and quality of the toilet wheelchair will be discussed. It will start from

defining the purpose of designing this toilet wheelchair, actual design of the wheelchair and finite analysis of the existing concept and optimization design.

1.2 Background

A wheelchair is a wheeled mobility device in which the user sits. There are two main kinds of wheelchair. They are the manual and powered ones. The most common types of wheelchairs are self propelled as powered wheelchairs are costly.

The basic designs for a wheelchair consists of two large rear wheels and two front caster wheels. Caster wheels are wheels that pivot freely about a point so that the wheelchair will able to move in any direction. There would be two movable leg rests, designed such that they can be easily turned away for the occupant to get out from the chair. There will be two handle bars above the backrest for helpers to assist in propelling the wheelchair.

The user pushes the wheelchair forward by turning on the outer rims of the wheels. To make a turn, the user simply has to control the direction and speed of both wheels to make the desirable maneuver.

1.3 Problem statement

Almost all wheelchairs are used as transportation for the elderly and disabled people. It is difficult to use a wheelchair every time they wanted to use the toilet. They have to change the position from the wheelchair to the toilet bowl. The problem in concept design is to study and optimize the structure to look stronger and safer. This concept design becomes more difficult because they do not have a proper dimension and has to study the dimension of the structure. Furthermore, the materials are not specific and need to be studied. After that, this concept design generate from problem wheelchair user like in figure 1.2.

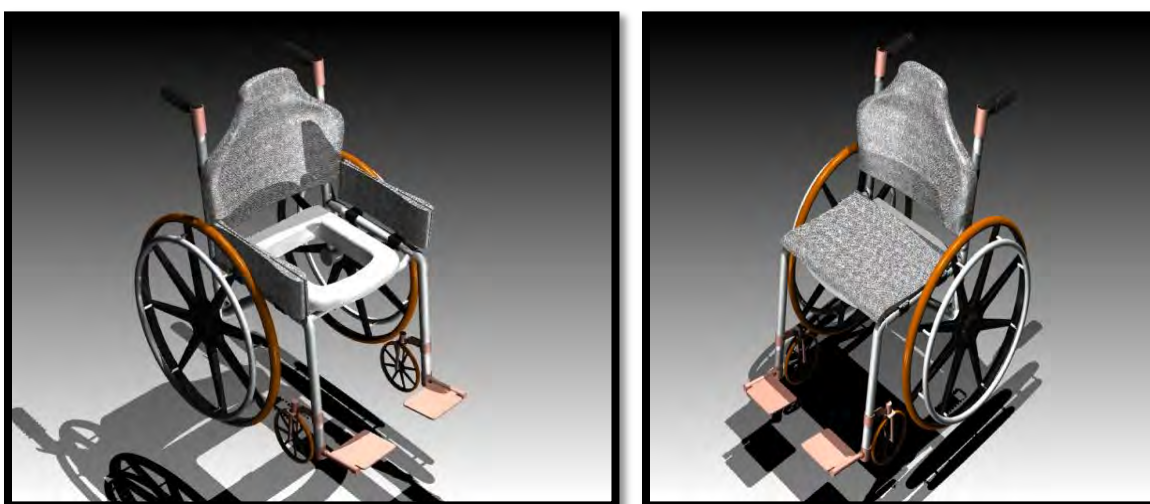


Figure 1.1 : Concept design

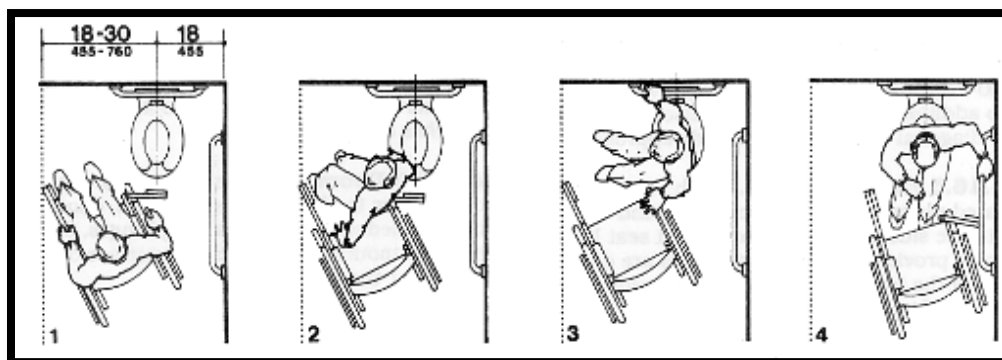


Figure 1.2 : Problem user

Figure 1.2 shows the users problem in the toilet. First step, wheelchair users have to take a transfer position diagonal to the toilet fixture, swings footrest out of the way and sets break. Second step, wheelchair users have to remove armrest and transfers. Third step, wheelchair user have to move the wheelchair out of the way and change the position (some people fold chair or pivot it 90 degrees to the toilet). Fourth step, wheelchair users have position on toilet bowl and releases brake.

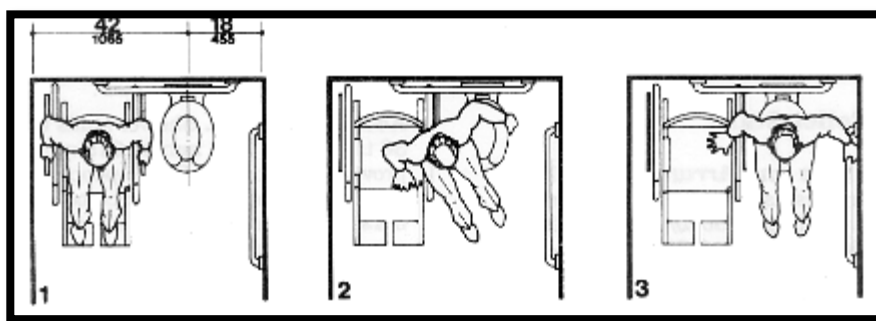


Figure 1.3 : Side approach

From the side approach, wheelchair users will transfer position parallel to the side of the toilet fixture, removes armrest and sets breaks. Second step, they transfer from wheelchair to toilet bowl. Third step, wheelchair users take the position on the toilet bowl.

From this picture, public toilets and restrooms can present accessibility challenge for people with disabilities, for example for those who used the wheelchair. To solve this problem, the main idea of this study is to design and optimize of a wheelchair that can help the elderly to visit the toilet and for their daily routine at their home.

1.4 Objective

The aim of this project is to improving, designing, optimizing, and analyzing the concept design. Throughout this project, the following objectives will be achieved:

- i) To obtain structure design analysis of current toilet wheelchair design concept for elderly and disabled people.
- ii) To optimize existing toilet wheelchair design concept for elderly and disabled people.
- iii) To come out with new idea to enhance the reliability and quality of the toilet wheelchair design.

1.5 Scope of study

The scope of this final year project is to study and design the toilet wheelchair using CAD software. This project will focus on:

- i) To study body design and analysis of toilet wheelchair using FEA.
- ii) To come out with new idea to enhance reliability and quality the existing toilet wheelchair design concept by producing digital design and modeling using CAD software.
- iii) Applying critical design analysis skills using necessary tools to gain results.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter describes the literature review that has been done to gain more information for this project. The beginning part of this chapter explains the history and types of wheelchair and toilet that are available in the market. This will be followed by information about the measurement of man and woman to use the wheelchair. After that, the secondary and primary research is done to develop a product design according to design process. Finally, information on toilet wheelchair design consideration will be available at the end of this chapter.

2.2 History

History of the wheelchair is hard to document on 1595. This was the year in which an artist drew a sketch of the Spanish King, Philip II of Spain (1527 – 1598), seated in a chair that had small wheels mounted at the end of each leg. Features of the chair included a raised platform for the King's legs and an adjustable back rest.

King Philip's chair was not self-propelled. He relied on a courtier or servant to push it. The first recorded instance of a disabled person with independent mobility was in 1655 when Stephen Farfler, a paraplegic watchmaker, built a robust-looking chair on a three wheel chassis. Attached to either side of the single front wheel were handles that Stephen turned to propel himself forward.

John Dawson is the next person who invented a special chair on 1783. Dawson worked in Bath, England, where many invalids travelled to drink and bathe in the spa water. Dawson's "Bath" chair, with its third wheel that the occupant could steer by using an attached rigid handle, was a great success. There were a number of versions, some of them open, some with hoods and glass fronts, but they all had to be pushed from behind or pulled by a small horse or donkey.

During the nineteenth century, wheelchairs became less cumbersome and more comfortable. As a result, some users were able to turn the large rear wheels with their hands, although this could be unpleasant if the chair ran through a patch of mud. The problem was solved in 1881 when manufacturers began to add a second rim with a smaller circumference to each wheel. These rims kept the hands clean and were known as push rims.

In the beginning of the twentieth century, wheelchairs had developed still further and boasted wire-spoke wheels, adjustable seat backs, and moveable arm and foot rests. There were also lightweight models made of wicker mounted on metal frames.

In 1916, British engineers had produced the first motorized wheelchair, although the majority of users remained in manual versions, which were becoming much cheaper. Despite this, the chairs were still rigid and difficult to store and transport, particularly in cars. Lastly on 1932, engineer named Harry Jennings from Los Angeles designed and built a folding wheelchair for his friend, Herbert Everest. The two men immediately saw the potential for this invention and established a company to mass-produce the new portable chairs. These were the forerunners of the wheelchairs in common use today.



King Philip II(1595) of Spain



Paraplegic watchmaker, Stephen Farfler
(1655)



Invented by John Dawson, "Wheel-chair
maker" (1783)



Lightweight wheelchair made from Indian
reed



Teamed with engineer, Harry Jennings, to
manufacture first folding metal
Wheelchair
(1932, Los Angeles)

Figure 2.1: Flow chart history of wheelchair

2.3 Types of wheelchair and toilet

2.3.1 Manual wheelchair

Human powers are require and used to move the manual wheelchairs. Many manual wheelchairs can be folded for storage or placement into a vehicle, although modern wheelchairs are just as likely to be rigid framed. To operate manual wheelchairs successfully, however, users must have a good standard of muscular ability and coordination of their arms and shoulders.



Figure 2.2 : Manual wheelchair

2.3.2 Electric power wheelchair

Electric Power Wheelchairs (EPWs) are designed specifically for indoor use, outdoor use, or both. They are generally design for persons who have difficulty in using a manual chair due to weak arm, hand, shoulder or more general disabling conditions. It is also because they do not have the leg strength to propel a manual chair with their feet and not a practice generally recommended by most Allied Health Professionals (AHPs). Electric Power Wheelchairs (EPWs) use electric motors to move the wheels. These are available in wet or dry options and currently dry cell batteries are more popular. Many EPWs carry an on-board charger which can be plugged into a standard wall outlet, older or more portable models may have a separate charger unit.



Figure 2.3: Electric Power Wheelchair

2.3.3 Sport wheelchair

Disabled athletes use streamlined sport wheelchairs for disabled sports that require speed and agility, such as basketball, rugby, tennis and racing. Each sport wheelchair tends to use specific types of wheelchairs, and these are no longer look like the manual wheelchairs. They are usually cannot be fold or non-folding (in order to increase rigidity), with a pronounced angle for the wheels (which provides stability during a sharp turn) and made of composite, lightweight materials. Sport wheelchairs are not generally for everyday use, and are often a second chair specifically for sport use, although some users prefer the sport options for everyday use.



Figure 2.4: Sport Wheelchair

2.3.4 Powerchair football

A new game has been introduced for the disables. They can also enjoy playing football. This new sport has developed chair for power chair users called power chair football or power soccer. It is the only competitive team sport for power chair users. The